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NON-TECHNICAL SUPPLEMENT

To add life to years, not just years to life

JULY 1946

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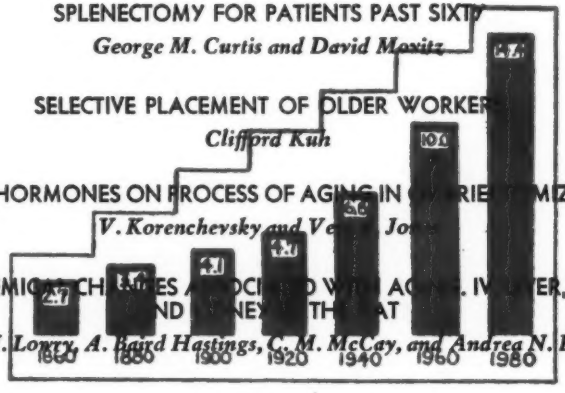

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The Relationship of Medical Practice to Gerontology

JAMES E. PAULLIN

THE science of aging as it affects all animate and inanimate objects is gerontology. Many people are conscious of the effects of the passage of time on various objects. The strong, sturdy mountain is seen gradually yielding to the effects of heat, cold, rain, snow, and sunshine. The house in which one lives gradually disintegrates from forces operating from without and from such destructive agents as use and abuse. The same forces, with others added, are effective against the life and usefulness of man.

During the past several years attention has been more sharply focused on the process of growing old because it was necessary to conserve all material resources to supply the immediate demands of prosecuting successful warfare. For this reason people were conscious of the destructive effect of abuse and lack of care on the various mechanical contrivances considered desirable and necessary for their standard of living. For example, in the use of automobiles people were told that in order to conserve the supply of gasoline, oil, tires, and the replaceable parts of a car, it was necessary that speed be lowered to a determined mileage per hour in order to prolong the

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period of usefulness of automobiles as well as to decrease accidents. This is a timely illustration of what can be accomplished in prolonging the usefulness of an automobile. Could man not profit by similar regulation?

The responsibility for initiating a study of the problems of aging and stimulating research concerning many of the questions they suggest is an ever increasing one. Geriatrics is that division of the medical sciences which concerns itself with the diseases encountered in, and responsible for, the acceleration of disability and death in those who are aging. This division of medicine, although comparatively old, has only within the past fifteen or twenty years occasioned much comment or study.

The process of aging begins immediately after conception, but only after birth can disuse and atrophy be observed. Then growth and evolutionary changes begin which eventually lead to the maturation of the individual as a person. Following or concomitant with maturation and again with the passage of time, *involutional* changes occur which cause a decline of bodily functions and the diminution or cessation of other activities which eventually lead to senility. Most people have accepted this aging process as routine, or the usual course of events, and have done very little to meet the problems presented by alterations in the physiologic, biologic, chemical, and physical processes involved.

In 1900, life expectancy in the United States was 47 years; in 1940 it was 63 years. This extension of sixteen years has been due chiefly to the accomplishments of the pediatricians in establishing better control of infectious disease, in the lowering of infant mortality, and in the adoption of better methods for the treatment and cure of disease. No longer is it possible to say that the prolongation of the life span is due to the survival of the fittest. Present day methods have made possible the survival of a great many children who are now, or soon will be, unfit to meet the problems of living. No better proof of this could be offered than the data submitted by Selective Service Boards pointing out the many physical and mental defects found among the draftees in World War II. Some of these defects were preventable, some remediable, others represent constitutional inade-

Words in italics are defined in the Glossary, page 184.

quacy and inherent weaknesses which sooner or later will make those so afflicted totally unfit for service and a financial burden on the family or government. Already there is a large group in this category showing premature evidence of pathologic aging and requiring increasing amounts of medical care.

Not only has there been an increase in the years of life expectancy, but there has been a marked increase in the number of persons in the decades beyond fifty. Since World War II, this increase in older people will be accentuated, which means an increase in those who will develop arteriosclerosis, hypertension, chronic nephritis, diabetes, cancer, the *arthritides*, degenerative diseases of the nervous system, and many other diseases of age. There will also remain a very large group who show only the normal amount of wear and tear from ordinary living.

A reasonable chronologic approach to the groups undergoing aging might include: group 1—the period of development from birth to age 20; group 2—the period of maturity from ages 20 to 40; group 3—the period of decline from ages 40 to 60; and group 4—the period of senility from 60 years onward. It is true that no hard and fast rule can be made in classifying every individual into one of the above categories, for it is well known that some people at 40 show changes characteristic of those at 60, while many people of 60 years and over maintain all of the vim, vigor, and mental alertness of the younger group.

Aging is a process which follows fairly well defined paths. At the same time it has been observed that its effect on people is influenced by many factors such as infections, intoxications, methods and manner of living, and other life experiences. One cannot but be impressed by the increasing evidences of aging which have been shown by many elderly people who have gone through the anxieties, sorrows, and burdens of World War II. Again using as an illustration the automobile tire, it cannot be said that all tires made by the same manufacturer are capable of giving the same amount of service. They may look alike and are all good up to a certain point; however, they then begin to manifest defects. Their usefulness depends on the quality of the fabric and the materials of which they are made, together with the care used in their construction. These are the factors which determine the amount of punishment the tire can withstand without

blowing out. With human beings, those who start life with good material handed down by ancestors are able to weather many storms without great damage. Heredity, therefore, determines to a greater extent than any other factor how well a person stands aging.

Certain evidences of aging are observed rather easily: A person is called old if he has gray hair, stooped shoulders, loss of weight, slight impairment of hearing, loss of subcutaneous fat, wrinkling, loss of elasticity, or inability to respond rapidly to sudden changes of stress and strain. What is it that accelerates or retards these changes? While there is no known answer, there are many speculative possibilities, most of which must be related to chemical processes occurring within the tissues and organs of the body which influence the nutrition of an individual cell or collection of cells, as well as the resistance which a cell or the cellular system is capable of offering against chemical changes. Physicians do not know the "modus operandi" of such processes, yet it is justifiable to assume that the question of nutrition is vitally concerned in any disturbance of the physiologic workings of human beings during the aging period. Where is the disturbance of nutrition at fault? Do people fail to consume an adequate diet, well distributed as to its content of carbohydrate, protein, fat, vitamins, and minerals, or does the fault lie with poor digestion, absorption, or utilization of these foods? Certainly in this day and time one could hardly suppose that anyone living within the sound of a radio would dare go without his quota of vitamins whether needed or not. Vitamins happen to be at the present time the universal fad, and there is scarcely a day that passes that patients do not first inform their physicians that they have been taking their vitamins regularly as advised by the radio announcer, but that they are no better and would like further advice. And aging goes merrily on.

What part is played by the endocrine glands in the acceleration or retardation of the aging processes? Unquestionably the diminution or the cessation of certain secretory products of the endocrine glands plays a part in aging, but maybe a very small part. Many other suggestions might be made of factors which influence the behavior of the human body from day to day. The question naturally arises: Can a standard be established based on present knowledge by which the physiologic needs of a given individual can be judged so that aging

will proceed in an orderly and equal manner without accentuating any one organ or system of the body for premature senility? To this there is no answer. However, with a greater interest and with well planned research into the unexplored domains of aging, great progress will be made.

It is generally accepted that involutional changes, which are characteristic of aging, begin at about 40 years of age and, though insidious in onset, later become more clearly manifest. At the same time there also begin those changes which result from degenerative diseases. In records of patients who have been observed over a long number of years, there can be seen in many the development of degenerative diseases which can be predicted upon the hereditary background or upon intoxications, methods and habits of living, and infections. This phase of geriatrics is one to which attention should be given, since the problem in this instance is not to seek the prolongation of life so much as it is to see that the lives of those who are aging are made more effective by preventing, delaying, or diminishing the progress of the degenerative state.

The first step in such a program for the successful practice of geriatrics should be that every person have a complete health inventory, which is a much more comprehensive survey of the individual than the usual so-called health examination, which often detects only the rather obvious defects and misses entirely the beginning of changes which may lead to serious consequences. Such a survey would determine the kind of an individual as well as his physical status. Such an inventory would require the aid of specialists. The patient should have explained to him all of the abnormal findings, particularly stressing the trends, and a safe and sane program outlined. One of the discouraging features of such a program is that such advice is wholeheartedly accepted and diligently followed for the time being only, or but halfheartedly accepted and not followed at all. How often has the physician seen the fat, *plethoric* man or woman of 50 years come for examination and advice. After a careful history, physical examination, psychological interview, and laboratory procedures, an over weight of 40 to 50 pounds and an elevation in blood pressure are detected. The patient states he has little diversion, is always in a hurry, struggling, worrying, and anxious. The physician spends hours

explaining to the patient just what is happening to him. The patient apparently is convinced and for the next few months follows advice, loses weight, curbs his appetite, exercises, and leads a life of moderation. Soon, however, he will revert to his old habits, and in another year will come with the story that he is feeling fine but is getting nervous, can't sleep, is restless and impatient. Why is it this patient has not continued to follow the advice previously given? Perhaps the medical profession deserves the criticism because physicians have not sufficiently or effectively impressed upon patients the importance of preventive measures. Perhaps methods similar to those used by pediatricians and dentists should be adopted, by calling patients in at regular intervals for check-ups. In this way the patient is conscious of a friendly interest in his welfare and is made to realize that his physician is interested in preventing the development of disability and disease.

More study, research, and clinical observation should be made over a long period of time on the diseases commonly encountered in those who are aging. The hope of discovering some etiologic factor involved in the production of these diseases will increase with such effort. Little is known about any of the diseases of age from a standpoint of prevention. Geriatrics is a division of the medical sciences in which there is a great opportunity for the medical profession to bring to those who are aging greater usefulness, happiness, and freedom from disabling and crippling disease.

Old age—that period in a man's life when he'd rather not have a good time than have to get over it.

ESAR

Splenectomy for Patients Past Sixty

GEORGE M. CURTIS AND DAVID MOVITZ

BACKGROUND

THE TERM "spleen" is of ancient origin but it has meant different things to different peoples. The word comes from the Sanskrit "plihan" through the Greek σπλήν; the Latin "splen," akin to the Latin "lien"; and the Old French "esplen." Today the spelling of the word is "spleen" or "lien" in every language.

The Greeks believed that the spleen was the seat of endurance in running, but in medieval and Renaissance times the spleen was considered the seat of emotions or passions, such as ill humor and anger. A survival of this latter belief is seen today in the expression, "to vent one's spleen upon. . . ."

Actually the spleen is an organ of the body situated on the left side behind the lowest rib. Normally it is from 4 to 5 inches in length and weighs from 3 to 10 ounces. When the spleen is of normal size it can not be felt, but if it is enlarged for any reason, the edge of the spleen can be felt by fingers pressing in just below the last rib.

The spleen is enlarged in many diseases, especially the infectious diseases. In the spleen there are certain bodies, known as malpighian

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This investigation was aided by a grant from the Comly Fund for Research of the Ohio State University.

corpuscles (named after the Italian anatomist, Malpighi), which manufacture lymphocytes, the white blood cells that defend the body against infection by attacking invading bacteria. If there is infection and an increased number of lymphocytes is needed, the spleen enlarges to accommodate the lymphocyte-producing function of the malpighian corpuscles.

Another function of the spleen is considered by some to be that of a reservoir for blood, until strenuous exercise or emergency of some kind calls for its release.

However, the chief known function of the spleen is to destroy old red blood cells. Red cells are made in the bone marrow, enter the blood stream, and carry oxygen for between thirty and ninety days. Then they are destroyed by certain large cells in the spleen, known as *macrophages*, which have the power to engulf the senile red cells. The oxygen-carrying red pigment (known as hemoglobin) of the red blood cells is broken down and becomes bile pigment, which is then excreted by the liver.

Sometimes the red cells are abnormally fragile and the spleen destroys more than it should. In this case, *hemolytic jaundice* may result. Hemolytic jaundice is usually *congenital* but may be acquired. In either case, removal of the spleen is eminently satisfactory treatment. The jaundice disappears within twenty-four hours, and usually does not return.

The spleen is also sometimes removed in cases of *thrombocytopenic purpura*. In this disease, there is destruction by the spleen of an excessive number of blood platelets, or thrombocytes, which control the clotting of the blood. Purple patches of hemorrhage appear beneath the skin and the mucous membranes of the body because there is an insufficient number of thrombocytes in the blood stream. When the spleen is removed, the immediate results are entirely satisfactory, for the hemorrhages cease almost immediately. Unfortunately, however, about half of the patients on whom *splenectomy* is performed for this disease, have a relapse. Some other organ of the body takes over the destruction of the thrombocytes, and in few weeks or years, the hemorrhagic, or purpuric, condition is back again.

The spleen has been removed in other diseases and for other rea-

Words in italics are defined in the Glossary, page 184.

sons, with widely varying results. As far as medical science can determine, persons who have had the spleen removed get along just as well as those who have not. However it must not be concluded from this that the spleen is an unnecessary organ. The fact that people do not suffer from lack of the spleen means that other organs of the body are capable of performing the functions of the spleen and take over when it is removed.

Dr. Curtis' and Dr. Movitz' Investigation

The increasing proportion of aged people in the population as well as a wider use of splenectomy for various *hematologic* disorders will result in the consideration of more and more elderly patients for splenectomy. Since 1850 the percentage of people between 50 and 64 years of age and of those over 65 has doubled, resulting from the two simultaneous factors of increasing longevity and a decreasing birth rate.

Pathologic states of the spleen requiring splenectomy are not peculiar to senescence since the spleen partakes of the general involution characteristic of senescence. After the age of 65 the spleen weight diminishes progressively, and the ratio of spleen weight to body weight decreases from the time of birth onward, although the absolute maximum weight of the spleen is reached at 26 years.

In a series of more than 200 consecutive splenectomies at the Ohio State University Hospital, there have been 14, or 7 per cent, performed on patients past 60. The general impression has been that these older patients have recovered fully as well as the younger ones following removal of the spleen. In 29 patients over 60, comprising 3.6 per cent of 776 splenectomies at the Mayo Clinic, the mortality rate was 20 per cent. In patients up to 39 years of age a 5 to 8 per cent mortality was noted, but above that age there occurred a progressive rise to 20 per cent in those 60 years of age and older.

Surgery in the aged is based on the principles fundamental to all surgery. However, these principles must be more rigidly observed in the aged because of the various abnormalities and decreased system reserves of senescence. Age itself, however, is no rigid criterion of the degree of degeneration of the various tissues or of other changes. Many an individual of 65 is in better physical state than one of 50. A critical appraisal must be made of the various systems and factors

to be reckoned with, especially those affecting the operative risk. In addition to those factors inherent in the primary disease requiring splenectomy, the cardiovascular and renal systems, the respiratory tract, the metabolic systems, the presence of focal infections, and the history of infectious diseases should be carefully evaluated. The body configuration, family longevity, nutritional status, mental state, occupation, and mode of living may each be significant.

Coincidental diseases, abnormalities, and senescent changes are evaluated so that such additional hazards may be dealt with suitably before splenectomy. Body deficiencies are treated preoperatively, and during this time the patient becomes accustomed to the hospital, its attendants, and the modified routine, a factor of great importance to the aged.

Immediately following removal of the spleen it is essential to search for and remove any accessory spleens which may be present lest they remain to cause recurrence of the splenic disease. In the series at the Ohio State University Hospital, however, few elderly patients had accessory spleens—only 18 per cent of those over 60 years of age.

In this series of 14 patients past 60 on whom splenectomy was performed, 2 died in the hospital. The others were improved or recovered from their primary disease. Preoperative evaluation revealed multiple senescent changes or diseases in each patient. In addition to the damage to the liver, which is often integrally associated with splenic disease, there occurred cardiac disease, hypertension, renal disease, pulmonary affections, and arthritis, all of which are more or less incidental to senescence. Other abnormalities found were syphilis, disturbed nutritional states with emaciation and obesity, and elevated *basal metabolic rates*.

Two patients died of postoperative hemorrhage in the hospital, but there were no operative deaths because of senescence, subsequent to splenectomy. After dismissal from the hospital, one patient died a year later and another, two and a half years later. These two deaths did not result from the disease which required splenectomy.

Postoperative hazards usually ascribed to splenectomy are the effects of associated liver damage, hemorrhage, and thrombosis and its effects. Both deaths in this series resulted from postoperative hemorrhage, primarily from the operative site.

Heart disease occurs in the aged so frequently that surgical inter-

vention must often be considered even in the presence of cardiac abnormalities. That surgical procedure is hazardous in the presence of congestive heart failure is indicated by the operative mortality rate of 14 per cent in 50 operations on patients with congestive failure. Patients with organic heart disease who are well compensated—that is, in whom circulation is good—withstand major surgical operations satisfactorily.

Arteriosclerosis, frequent in older patients, apparently reduces the reactivity of the circulatory system to sudden volume changes. Therefore, replacement of whole blood should be prompt and adequate. The fluid and mineral balance should be carefully maintained to protect the kidneys and heart rather than to burden them. Prevention of pulmonary *stasis* along with good nursing care will also give the aged patient the best consideration.

In the Ohio State University Hospital series, splenectomy for the large percentage of older patients who survived the operative procedure has proved worthwhile from two points of view: The patients were improved or recovered from the splenic disease, and their expected length of life has suffered little or no interference from the previous splenic disease.

DO YOU KNOW?

Titian painted up to his 99th year.
Goethe wrote into his eighties.
Justice Oliver Wendell Holmes was keenly alert at 94.

Selective Placement of Older Workers

CLIFFORD KUH

THE PROPER placement at work of older workers requires, as in the case of any worker irrespective of age, the evaluation of experience, skills, and physical capacities in relation to the demands of the job. At the Permanente Foundation Hospital the staff has been particularly interested in the physical capacities of workers, leaving the evaluation of other characteristics to the employment agency representative, the personnel man, or the industrial psychologist.

Heretofore in the selective placement of workers, the industrial physician has been accustomed to classify workers, actually or by inference, into about four groups: (1) fit for any work, (2) fit for moderate work, (3) fit for light or sedentary work, and (4) fit for no work. It was then the function of the placement officer to interpret these broad classifications when attempting to place the worker on a specific job. Just what is meant by "moderate work" or "light work" is a matter of individual interpretation. There is little scientific justification for such classifications.

The first significant attempt to break away from unscientific procedures came when research workers in the field of job placement began to analyze the physical and environmental demands of particular jobs. With such information available concerning jobs, it was natural to inquire whether they could be performed by individuals with specific physical defects, as, for example, lack of one arm or one leg or high blood pressure. Lists were then prepared of jobs in an industry or group of industries performable by individuals with specific

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handicaps. Such lists have been the basis of a number of placement programs.

However, there are inherent weaknesses in this approach to the problem of job placement. Specific physical defects are not invariably easy to classify. Take, for example, heart disease, which can be broken down into many categories. A list of jobs performable by individuals with each type of heart disease would have to be prepared, for it is obvious that a comprehensive list of jobs performable by individuals having heart disease in general, has little practical value. A job for a young worker with rheumatic heart disease would not suit an aged man recovering from *coronary thrombosis*.

Furthermore, it is sociologically undesirable to single out individuals with physical defects. This procedure tends to segregate handicapped persons and increase the difficulty attendant upon placing them in industry. Theoretically, there is no reason why a placement program cannot be adapted to the placement of nonhandicapped workers as well as handicapped. So the conclusion must be drawn that in the final analysis the proper placement of a worker on a job is the placement which matches the specific capacities of a worker with the specific demands of a job.

These were some of the considerations that led the staff at the Permanente Foundation Hospital, with the assistance of Bert Hanman, a job analyst and expert on placement, to investigate whether the same terminology could not be used to analyze the physical characteristics of both people and jobs. Two subdivisions were to be considered—the job itself and the job's environment. If this type of analysis could be effected, the problem of placement would be appreciably simplified. Further study of the question led to the conclusion that this could actually be accomplished.

The following list of twenty-five mechanical factors was prepared as a basis for analyzing both jobs and workers at the Kaiser shipyards:

Mechanical Factors

1. Lifting
2. Carrying
3. Handling
4. Pushing
5. Pulling
6. Climbing
7. Jumping
8. Running
9. Walking
10. Standing
11. Stooping
12. Crouching

Words in italics are defined in the Glossary, page 184.

13. Kneeling
14. Crawling
15. Twisting
16. Reclining
17. Sitting
18. Reaching
19. Fingering
20. Feeling
21. Talking
22. Hearing
23. Seeing
24. Color Vision
25. Depth Perception

Consider the item, "lifting," for example. The job analyst can definitely determine how much lifting, if any, a specific job requires. The industrial physician can say whether or not an individual worker should be restricted in respect to lifting, and, if so, what maximum weight he should lift. Therefore, the placement officer can say whether the worker is suited to the specific job.

Likewise, the following list of twenty-five environmental factors was prepared:

Environmental Factors

1. Inside
2. Outside
3. High Temperature
4. Low Temperature
5. Sudden Temp. Changes
6. High Humidity
7. Low Humidity
8. Toxic Conditions
9. Radiant Energy
10. Moving Objects
11. Mechanical Hazards
12. Electrical Hazards
13. Exposure to Burns
14. Explosives
15. Vibration
16. Noise
17. High Places
18. Cramped Quarters
19. Wet Quarters
20. Working With Others
21. Working Around Others
22. Working Alone
23. Day Shift
24. Swing Shift
25. Graveyard Shift

For example, a man of 70 who has arteriosclerosis, chronic *bronchitis*, normal blood pressure, and corrected distant and near *vision of 20/40* and Jaeger 2, respectively, in each eye, may be considered. His physical capacities might be as follows: May lift and carry, or push and pull, up to 25 pounds six times per hour, one hour a day. May walk, stand, stoop, crouch, and kneel up to three hours. No climbing, jumping, running. No outside work, exposure to sudden temperature changes, or work in wet quarters. Day shift only.

This worker could be used on many jobs. Specifically, the job of welder in the reclamation shop may be considered. The job's analysis is as follows: Stands and reaches forward into bin to grasp, lift, and carry steel strips weighing up to 10 pounds about 10 feet to work

bench (one hour). Sits at bench 30 inches high and reaches forward to handle 1-pound electrode holder during welding process and to handle light wire brush and slag hammer while cleaning weld (seven hours). Stands, stoops, and reaches down to handle controls to adjust electric generator (one half hour). Must be able to see $\frac{1}{8}$ inch rod tip at 12 inches. No talking or hearing required. Physical factors similar on day and swing shifts. Works day or swing shifts inside reclamation shop. Exposed to black-iron welding fumes, to rays from electric welding arcs, to sharp edges of materials, to uninsulated parts of electrode holder, and to hot metals and electric arcs. Environmental factors similar on day and swing shifts.

Now if this particular worker's capacities are considered it will be seen that—despite his age and handicaps—he can fill the particular job in respect to every physical and environmental demand.

During the first eighteen months the program was in effect, 10,000 physical capacities analyses were made for all sorts of disabilities, many of them among older workers.

Surprisingly, the technique's greatest usefulness was in getting a disabled worker back to work sooner than otherwise would have been the case. Ordinarily, a physician might wait until a fractured arm or leg was completely healed and then return the man to his original job. But with the aid of the physical capacities analysis the doctor could very easily assign the injured worker to other temporary work, merely indicating for the man with a cast on his leg: "No climbing for six weeks." This recommendation might keep a partly recovered welder off the boats, but his services could be used in pipe or plate shop. This earlier return to work not only speeded shipbuilding, but prevented pay loss and was good for the worker's morale.

In general it might be said that until more is known concerning the relationship between clinical data and physical capacities, the physician's judgement is probably the best and only guide in the placement of workers. However, the *cardiologists* attempted to develop certain criteria. For example, the physical examination, *electrocardiogram*, chest x-ray for heart size, and past history in respect to arduousness of work were all taken into account. Tabulation of criteria for guidance of staff physicians has been done for hypertensive heart disease, coronary arteriosclerotic heart disease, rheumatic heart disease, syphilitic aortic valvular disease and *congenital* heart disease.

The placement of the first 84 cases of coronary thrombosis was analyzed, and it was found that of 56 patients who had returned to work, 30 had been working over a year, 19 of them on the same job, 11 on lighter work. Of the 19 back on the same work, 15 were doing manual labor. The cardiologists believed that patients recovering from coronary thrombosis had practically a 50-50 chance to return to hard, manual work. It could not be assumed, therefore, that serious heart disease invariably doomed a laborer to change of job. When it did, however, proper placement to prevent the ill effects which might result from a worker's exceeding his capacities could best be made by a carefully executed program.

Despite the fact that aged men could fill many jobs as far as their physical capacities were concerned, it was found that older men were not getting certain jobs. For example, they were frequently barred from welding. Like most persons in advanced years, these older people wore bifocal glasses with lenses divided for distant vision at the top, near vision below. The welding hood covered the lower part of the lens and made it practically impossible for them to work. The solution was found in grinding a correction for near vision into glass placed in a plastic plate which could be slipped into the welding hood itself.

Such assistance to older workers illustrates the kind of planning that can be done to suit to the aged, jobs for which they would not otherwise be fitted. If a machine operation requires too much pulling, the plant engineer might possibly rearrange the length of levers to reduce the effort required. Where such job reengineering is not possible the older worker should be transferred to work he can do. The same finger dexterity, for example, cannot be expected in a man of 80 that he possessed at 20.

There are, of course, workers, both old and young, who cannot earn a living because they have completely lost their previous skills through accident or illness or the passing of time. These persons should be trained for new work. An aged laborer who can no longer work standing on his feet may earn a living at sedentary work.

Thus, an outgrowth of the selective placement program was the establishment of a rehabilitation service for incapacitated shipyard workers through the cooperation of the State Bureau of Vocational Rehabilitation. A representative of the bureau called at the hospital once a week to work with candidates for rehabilitation. The bureau

required a full report on each candidate for rehabilitation, setting forth his physical capacities, diagnosis and prognosis.

In general, the experience, herein discussed, in the employment of older workers in the shipyards during the war supports the contention of students of the problem—namely, that aged persons can become satisfactory workers. The war brought to pass automatically what social planners had been trying to achieve for many years through education or mutual agreement—the employment of older persons. I recall back in 1939 through the efforts of an assemblyman, James J. Wardsworth, the clothing industry in upper New York State entered into an agreement to employ the same percentage of people over 40 as existed in the local population. Mr. Wardsworth wrote recently that the war eliminated the need for this agreement because older people found their way into industry. Since the aged have proved their worth during the war, it is hoped that the future will see a greater proportion of them kept in industry and properly placed on work they can do. When the aged are placed more efficiently, it can be expected that a good record will be further improved.

At about the time one learns to make the most of life, the most of it is gone.

Effect of Hormones on Process of Aging in Ovariectomized Rats

V. Korenchevsky and Vera E. Jones

Background

One of the most important problems before the scientist interested in aging is an analysis of the causes of the changes that occur in advanced years.

In women there is a so-called "change of life" at the age of 45 to 50 years. Whether or not there is a similar period in men is debatable. In women the visible evidence of this time, known as the menopause or climacterium, is a cessation in the monthly menstrual flow. Less obvious changes are an alteration in the lining of the vagina, an increase in the *gonadotrophic* hormone in the urine, and many others.

Dr. V. Korenchevsky, a Russian by birth, was formerly professor of experimental pathology at the Imperial Medical Academy in Petrograd. He received his M.D. degree from Moscow University. In 1920 he emigrated to England, becoming a naturalized British citizen. He was senior research worker at the Lister Institute of Preventive Medicine in London. He was an initiator of and active in the foundation, in 1939, of the Club for Research on Ageing, with branches in Europe, the United States, and Argentina. Dr. Korenchevsky is now Hon. Secretary of the British branch. In 1945 he was appointed head of the Gerontological Research Unit at Oxford, establishment of which was made possible by a grant from Lord Nuffield. Hospitality has been extended to the Unit by Prof. A. C. Hardy and Prof. E. G. T. Liddell of the department of zoology and the department of physiology at Oxford University. The subjects of research in which Dr. Korenchevsky is most interested include endocrinology, the study of vitamins, and gerontology.

Dr. Vera Evelyn Jones obtained her B.Sc. degree in zoology in 1941 and her Ph.D. degree in 1944 at Liverpool University. She has been a research worker at Liverpool University and at Reading University, National Institute for Research in Dairying. Since January, 1945 she has been with the Gerontological Research Unit at Oxford University. Her work has been chiefly with cancer research and gerontology.

Ciba, Ltd., in particular Dr. K. Miescher, supplied the hormones used in the experiments here reported on, and Parke, Davis, and Co. supplied the desiccated thyroid.

Words in italics are defined in the Glossary, page 184.

There can be little doubt that some of the alterations in structure and function in older women as compared to young women are related to the decreased activity of the ovaries.

Dr. Korenchevsky and Dr. Jones set about to analyze a few of the effects of removal of the ovaries in white rats and to determine how administered hormones may modify the process. Their report is divided into two parts: the effects on the weights of organs; and the effects on the structure of organs.

Now for the First Study of Dr. Korenchevsky and Dr. Jones

Two series of experiments were performed to determine the effects of ovariectomy and the effects of certain hormones on the weights of organs. One hundred and seventy-seven rats, both with and without ovaries, were used as controls. No hormones were given to them. Hormones were given to 93 female rats, all of which had their ovaries removed. The sex *hormones androsterone* and *estradiol* were injected *subcutaneously*, and thyroid hormone was given both subcutaneously and directly into the stomach. The organs were weighed after they had been placed in a fixing solution. All results were analyzed statistically. The table shows some of these results.

Effect of Hormones on Actual Weight of Organs

Organs	Normal Controls	Ovariect. Controls	Thyroid Hormone (large dose)	Estradiol (medium dose)		Androsterone		
				alone	+thyr. hor. (large dose)	alone	+thyr. h.	+thyr. h. & estrad. (large dose)
Body Wt.	216 gm.	235 gm.	216 gm.	207 gm.	215 gm.	278 gm.	233 gm.	230 gm.
Uterus	419 mg.	31 mg.	31 mg.	241 mg.	279 mg.	33 mg.	33 mg.	314 mg.
Vagina	304 mg.	164 mg.	175 mg.	289 mg.	324 mg.	214 mg.	216 mg.	370 mg.
Adrenals	61 mg.	55 mg.	86 mg.	84 mg.	135 mg.	42 mg.	70 mg.	123 mg.
Pituitary	15.3 mg.	15.4 mg.	14.2 mg.	19.8 mg.	19.8 mg.	15.2 mg.	14.7 mg.	18.7 mg.
Liver	6.94 gm.	6.79 gm.	9.17 gm.	8.01 gm.	11.55 gm.	8.78 gm.	9.99 gm.	10.57 gm.
Kinneys	1.51 gm.	1.44 gm.	2.12 gm.	1.60 gm.	2.54 gm.	1.65 gm.	2.18 gm.	2.60 gm.
Heart	784 mg.	768 mg.	1123 mg.	813 mg.	1200 mg.	893 mg.	1162 mg.	1110 mg.

After removal of the ovaries, female rats generally weighed more. They likewise tended to become longer. Fat deposition was frequently increased, but not to the point of obesity. The uterus and vagina be-

came small and nonfunctional after ovariectomy. The thymus, a gland in the neck, became larger after ovariectomy. Other organs, while not significantly decreased in absolute (i.e., actual) weight, were decreased in relative weight after removal of the ovaries. These organs included all of the nonsexual organs examined. The *adrenal* glands decreased both in absolute and relative weight after ovariectomy.

In contrast, aging rats, the ovaries of which were not removed, showed a decrease in size in only a few organs, such as the liver, kidneys, and pituitary gland, and this decrease was smaller than that found in the respective organs of ovariectomized rats. Thus, rats apparently aged more rapidly after an artificial climacterium was produced by ovariectomy.

After accumulating these data on the effects of ovariectomy and normal aging on the size and weight of organs, hormones were administered in varying doses and combinations.

Small doses of thyroid hormone either did not affect body weight and body growth or slightly accelerated it. Rather large but nonpoisonous doses depressed growth. The adrenals, liver, kidneys, heart, spleen, and pancreas became enlarged when thyroid hormone was given. Body fat decreased. In order to get a maximum effect of thyroid, an adequate intake of vitamins was necessary.

When the male sex hormone androsterone was given to normal female rats, the uterus was usually slightly enlarged, as were the liver, kidneys, and heart. Fat deposition was slightly increased. On the other hand, the adrenals and the thymus were decreased in size. On the evidence of changes in body weight, fat deposition, and organ weight, androsterone can be classified as a general growth-promoting hormone with the exception of its effect on the adrenals and thymus.

When the female sex hormone estradiol was given, body weight of ovariectomized rats was generally decreased. Likewise such organs as the thymus, brain, spleen, and kidneys were always decreased in size. However, other organs such as the uterus and vagina were increased in size, and large doses resulted in an increase in actual weight of the liver, adrenals, and pituitary gland. Excessively large doses caused degenerative changes in many organs. Thus estradiol may both stimulate and depress growth.

A *synergistic* activity between thyroid hormone and estradiol

seemed to be certain. This effect was especially marked in an enlargement of the adrenals. A similar correlation of effect was seen in the liver and kidneys. Some effects of estradiol were not changed by simultaneous administration of thyroid hormone, while some effects were reversed—for example, the weight of the spleen, decreased by estradiol, was returned to normal after injection of thyroid hormone.

The correlative effects of androsterone and thyroid hormone were also studied. The weights of the sex organs and the thymus after combined therapy were the same as those with androsterone alone. The weights of the nonsexual organs were approximately the same as those of animals treated with thyroid hormone alone. However, large doses of thyroid neutralized the decrease in size of the adrenals produced by androsterone alone.

The correlative effects of thyroid hormone, androsterone, and estradiol together were studied. In general, simultaneous administration of the three hormones was characterized by making larger those organs which were made larger by the two more powerful hormones of the three, thyroid and estradiol. The effects of androsterone on organ weights were seen only when small doses of estradiol and thyroid hormone were used.

Now for the Second Study of Dr. Jones and Dr. Korenchevsky

Studies were made of the *histologic* structure of the liver and kidneys of the same rats used in the first study in order to determine exactly what brings about the decrease in size, and to measure the effect of three hormones—thyroid hormone, androsterone, and estradiol—on histologic structure.

In the liver, the normal rate of multiplication of the cells, known as *mitoses*, decreased with age or after ovariectomy, which accounted for the decrease in size of the organ. In the kidney, the same explanation held. In addition, the cells of the kidney were themselves smaller than normal.

Small doses of thyroid hormone had no appreciable effect on the size of the liver. However, large doses increased the rate of multiplication of the liver cells. In the kidney, the rate of multiplication of the cells was not significantly changed, but the size of the cells was increased after administration of thyroid hormone.

Androsterone had no appreciable effect on the rate of multiplication of the cells, but it increased the size of the cells of both liver and kidney.

Estradiol likewise increased the size of the liver and kidney cells, and, in the liver, increased the deposition of *glycogen*. However, it seemed that very small doses of estradiol had a depressing effect on the size of the liver.

Although some synergistic effects were observed when all three hormones were administered, it was found in general that the effects of a large dose of thyroid hormone predominated over the effects of estradiol and androsterone.

Interpretation

It is clear from these experiments that removal of the ovaries in white rats brings about changes in several organs, in some respects analogous but of greater degree, to alterations observed in older rats in which the ovaries have not been removed. It is also definite that a combination of the female sex hormone estradiol, the male sex hormone androsterone, and the thyroid hormone will prevent most of the changes which follow removal of the ovaries. Thus, these hormones appear to have an anti-aging effect on the *involution* of some organs examined.

The application of these facts to the situation in women is beset with great difficulties. In women there is a virtual cessation of the activity of the ovary at the menopause, normally occurring between the age of 45 and 50 years. In rats, there is no comparable loss of ovarian function at a given age. It is not known whether a more prolonged artificial stimulation of the organs of aged rats would or would not be followed by paralysis of these organs.

On the other hand, the studies of Korenchevsky and Jones do give an indication of the part that loss of ovarian function plays in the changes in women over 50 years of age. Extension of these investigations may point the way to some practical application.

Histochemical Changes Associated with Aging

IV. Liver, Brain, and Kidney in the Rat

OLIVER H. LOWRY, A. BAIRD HASTINGS,
C. M. MCCAY, AND ANDREA N. BROWN

GENERAL BACKGROUND

ONE of the most important components of living matter is water. In fact, from a materialistic standpoint only, man is just 70 per cent water. The turnover in water each day is phenomenal. Normally, about five pints are lost to the body each day—30 per cent in the urine, 3 per cent in the feces, 12 per cent through the lungs, and

Dr. Oliver H. Lowry, of the Public Health Research Institute of the City of New York, received his B.S. degree from Northwestern University in 1932, his Ph.D. from the University of Chicago in 1937, and his M.D. degree from Rush Medical College in 1937. From 1937 to 1942 he was in the department of biological chemistry at Harvard Medical School, and since 1942 has been associated with the division of physiology and nutrition of the Public Health Research Institute. His work has been chiefly concerned with tissue electrolytes and old age.

Dr. A. Baird Hastings is Hamilton Kuhn professor of biochemistry at Harvard University. He received his B.S. degree from the University of Michigan in 1917, his Ph.D. from Columbia in 1921, a Sc.D. from the University of Michigan in 1941, and an A.M. degree from Harvard in 1942. He has been associated with the U. S. Public Health Service, the Rockefeller Institute, and the University of Chicago. His studies include research on the physiology of fatigue, acid-base equilibria, biological oxidations, and microhistochemistry.

Dr. C. M. McCay has been professor of nutrition at Cornell University since 1934. He received his A.B. degree from the University of Illinois in 1920, his M.S. from Iowa State College in 1923, and his Ph.D. from the University of California in 1925. He has taught at the University of Texas, Iowa State College, the University of California, and Yale. His work includes studies on chemical physiology and its application to growth, the physiology of lactation, and nutrition and growth in relation to the life span.

Miss Andrea N. Brown received her B.S. degree from Wellesley College. She has recently retired from investigative work to private life.

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55 per cent in the sweat. If there is a deficiency of water intake or an excessive loss of fluid from the body, the tissues become too dry and the body is dehydrated. If there is an excessive decrease in the excretion of water, too much water in the blood may result, and fluid may accumulate in the tissues, resulting in swelling, or edema.

The investigator is interested not only in the intake and output but also in where the water is inside the body. It is customary to recognize three large compartments: that water in the blood and lymph (intravascular water), that water inside of cells (intracellular water) and that water between cells but not inside blood or lymph vessels (extracellular water).

Methods of Study

Many different methods have been developed to measure the amount of water in each of the three compartments.

One group of methods is based on the fact that certain dyes and other chemical substances do not leave the blood vessels or do not enter cells readily or quickly. Thus, if a small amount of the proper dye is injected into a vein, the dye will within a few minutes be equally distributed in the blood, but none or very little will have left the blood. A known amount of blood may then be taken and analyzed for the dye. In simple terms, if one ounce of dye is injected, and on analysis there is one-fourth of an ounce of dye in one pint of blood, it follows that there must be four pints of blood in the body.

Another group of methods is based on chemical analyses of tissue and is termed the "deductive histochemical method." This method is based on the fact that tissue cells differ radically in chemical composition from the surrounding fluid. These differences are known, and hence, if a sample of tissue containing both cells and fluid is analyzed, it is a relatively simple problem in arithmetic to calculate how much of the sample was cells and how much was extracellular fluid.

Relation to Aging

Since time immemorial man has noticed that older individuals have a wrinkled skin and appear less well nourished than younger persons. Some have attributed this change in part to a decrease in the water content. Hence, the recommendation of some physicians that the older person should drink a definite quantity of water each day.

Actually our knowledge of the turnover and demands for water and of the relations of the body water in the three compartments is not sufficient to make any recommendation.

Dr. Lowry and his associates have been interested in this problem for several years, and this paper is one of several on the subject. Previous investigations showed that in the muscle of the rat, aging is associated with a decrease in the relative mass of fibers and a concomitant increase in extracellular fluid.

NOW FOR THE INVESTIGATION OF DR. LOWRY, DR. HASTINGS, DR. MCCAY, AND MISS BROWN

The present report is concerned with certain chemical changes, with aging, in the liver, brain, and kidney of the white rat.

These three organs—liver, brain, and kidney—were secured from 90 rats which varied in age from 60 to 988 days. (A rat is beginning to get old at 500 to 700 days.) Chemical analyses of the organs for various substances were performed, and calculation of total intracellular and extracellular material was made. With some organs, other factors such as amount of fat and amount of supporting tissue had to be taken into consideration.

TABLE 1. RELATIVE AMOUNTS OF EXTRACELLULAR AND CELLULAR MASS IN LIVER, BRAIN, AND KIDNEYS OF NORMAL RATS, 60, 603, AND 988 DAYS OLD.

Organ	Total Extracellular	Total Cellular
Liver		
60 days old	219	781
603 days old	197	893
988 days old	211	789
Brain		
60 days old	302	622
603 days old	310	594
988 days old	315	598
Kidney		
60 days old	280	720
603 days old	413	587
988 days old	441	559

Some of the results on normally fed rats are condensed in table 1. It is apparent that there is little or no change in the relative amount of extracellular and cellular mass in the liver and brain, with aging.

On the other hand, the kidney shows a conspicuous decrease in total cellular mass and corresponding increase of total extracellular mass.

In contrast with this relatively large change, the chemical changes given in table 2 for selected components show only minor changes in the absolute amounts of certain chemical substances in the cells themselves.

TABLE 2. ABSOLUTE AMOUNTS OF CERTAIN COMPONENTS OF LIVER AND KIDNEY PER KILOGRAM (2¼ POUNDS) OF CELLS AT VARIOUS AGES.

Organ	Acid Soluble Phosphorus	Total Phosphorus	Potassium	Magnesium
Liver				
60 days	82	210		
603 days	80	194	175	33
988 days	76	200	178	34
Kidneys				
60 days	83	220	153	
603 days	82	208	160	
988 days	76	200	145	

INTERPRETATION

These studies show that aging is not a uniform process involving all cells and organs at once and to an equal degree. Hence all studies on aging and all efforts to correct or modify the processes of aging must be directed to a specific organ, not at the body as a whole.

The studies further demonstrate that although there is loss of cells with aging, there is insignificant change in the chemical composition of each cell so far as the substances tested for are concerned. Perhaps other vital materials present in small amounts may be altered.

The results support the theory that changes with aging are the effect of loss of functional cells and alterations in tissue architecture, rather than decrease in the functional capacity of each cell.

Age and Infection—a Review

FRANCISCO DURAN-REYNALS

THE GREATER susceptibility of the young to acute infection was probably one of the oldest of empirical medical observations. From this observation and from the results of experimentation, the concept has emerged that there is an increasing resistance to many infectious diseases which parallels the growth of the individual so that infection is lessened with age. This concept holds true generally, despite the fact that there is a possible drop in resistance in advanced old age and the fact that in some cases it is not resistance but susceptibility that is acquired by maturation and aging.

The greatest contribution to an understanding of the modifications of infection by age would be the exposure of the fundamental laws that are responsible for these modifications. Although the data available are many, they are often so scattered that it is difficult or even impossible to arrange them coherently.

A most important question is whether it is the cell or the whole organism which acquires resistance to infection. Unfortunately, there is as yet no complete answer. The most efficient resistance possible would be a lack of attraction between parasite and cell. Some bacteria for example, show this type of resistance to the sulfa drugs. Other bacteria are resistant to the destructive effects of *bacteriophage*.

It has not yet been proved that this inherent lack of attraction between destructive agent and cell is a form of resistance present in higher organisms than bacteria. However, it is known that certain *virus* diseases are *pathogenic* only for certain species—for example,

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Born in Barcelona, Spain, Dr. Francisco Duran-Reynals received his M.D. degree there. He held a fellowship at Pasteur Institute at Paris in 1925–1926, and was first an assistant and later an associate at the Rockefeller Institute between 1926 and 1938. He has been associate professor of bacteriology at the Yale University School of Medicine since 1941. His studies have been concerned with filterable viruses, cancer, and the importance of the factors altering the permeability of tissues in physiologic and pathologic processes.

Words in italics are defined in the Glossary, page 184.

there is a virus which infects rabbits but not rats or guinea pigs. Thus it is almost certain that the natural resistance of some species to some infections is caused by a *congenital* refractory state of the cell, and it may well be that a lack of affinity between cell and parasite is the basis of this refractory state.

Whether the cell can acquire a resistance to an infectious agent and transmit it to its descendants is not known. There is evidence on both sides.

However, it is known that the whole organism acquires resistance in the process of aging. The body has several means of resistance to infection. One is the development in the growing individual of more and more *antibodies*. Whether this increase in ability to manufacture antibodies is the direct result of the aging process itself or whether it is the result of infections too slight to be detected is still controversial. Another means of resistance that improves with age is the function of *phagocytes*, primarily the white blood cells, which destroy bacteria by engulfing them. Still another important factor in resistance is the decrease in tissue permeability that comes with age. When the tissues are highly permeable, as in young individuals, an infectious agent is dispersed over a large area and the infection is enhanced to a considerable degree.

The most conclusive data on the relation of age to resistance are obtained from experiments with *neoplastic* diseases caused by viruses. Most of these experiments have been performed on chickens, for among animal species the chicken shows probably the highest incidence of cancer, and the tumors that develop are in every way comparable to those that occur in other animals and in man.

Paralleling the growth of chickens, the blood serum develops the power to neutralize many harmful agents, including the viruses which produce cancer. The embryo and the newborn chick are practically devoid of any demonstrable defense and accordingly are extremely susceptible to neoplastic viruses. However, these very vulnerable chicks do not respond to injection of tumor viruses by developing cancer. If a sarcoma virus is injected they develop a non-neoplastic condition known as hemorrhagic disease. The virus attacks the walls of blood vessels, and the blood pressure causes the weakened wall to give way and finally rupture, causing death by hemorrhage. On the other hand, cancer is produced in adult chickens by injection

of the virus or of infected tissue from chicks, and cancer is produced in chicks likewise if blood serum from normal adult chickens is given to the chicks after the sarcoma virus has been injected. Other tumor viruses produce other effects in chicks, such as *necrosis* of the heart and liver and inflammatory lesions—but not cancer. Thus it is seen that neoplasia is only one phase in the life history of a virus. This phase is manifested only when the host is endowed wlith a certain degree of resistance to the virus, which resistance is associated with the aging process.

The age factor also enters into a determination of whether a virus from a given species, such as the chicken, will infect another species—for example, the duck—and whether the virus will adapt itself to the second species. For the duck to be infected with a chicken tumor the duck must be injected with the tumor shortly after hatching and the tumor must come from an adult chicken. Two types of lesions, early and late, may develop in the duck following these injections. The early lesions which develop a few weeks after the injection, consist of hemorrhagic blebs such as occur in chicks, occasionally combined with small tumors. Transplantation of these tumors into older ducks fails in every case, but transplantation into chickens induces tumors identical to the original sarcoma. In other words, the virus does not vary or adapt itself in the duckling but remains a chicken virus. However, the late lesions, developing many months after injection, consist of tumors of different sorts which, on transplantation, grow well in ducks of practically any age and in chicks, but grow poorly if at all in adult chickens. Thus it is seen that infection may take place very early in life but may not manifest itself until much later, at which time the infectious process may have become greatly modified.

The effects of various *hormones* must also be mentioned. Continuous treatment with *estrogens* results in the same increase in resistance that is observed with advancing age. Estrogen enhances the production of antibodies and lowers tissue permeability. It has been shown that estrogen protects against certain diseases, such as syphilis, which have been produced experimentally, and is able to cure some spontaneous human diseases. Other hormones, however, have opposite effects—they increase permeability and so lower resistance.

No doubt age resistance in some cases suppresses infection completely. On the other hand, the examples given of neoplastic viruses

show that unquestionably in other cases the infection is only modified by age. Thus the question arises: How many diseased conditions of the aged are merely modified forms of known infectious processes of the young? Since the days of Pasteur and Koch it has been the acute infection, the infection of the young, that has been almost exclusively studied, and, as statistics show, it is the young who have most benefited from medical research. The systematic study of infection of the old has not yet started.

People are resigned to aging because everybody does age, inevitably. Yet, how many manifestations of senility may be of a remote infectious origin and, therefore, theoretically avoidable? If cancer is considered as a typical episode of aging, at least some forms of the disease would fall into the avoidable category. How many other diseases of old age will time show to be avoidable? What would old age be like in a sterile world?

You can be dead sure you are growing old
If you can no longer make friends easily;
If you wish to be by yourself;
If you find yourself living in the past;
If you think people are more dishonest, trickier, meaner, stupider than they used to be.

Your Life.

British National Health Insurance—the Workers' Pride

ELIZABETH W. WILSON

THE STORY of the first thirty years of the British system of national health insurance is one of growth but little change. If both the German system, discussed in the preceding issue of the JOURNAL OF GERONTOLOGY, and the English system could be represented pictorially at their beginnings and again at the latest dates for which there are complete data, the picture of the German system in 1938 would bear as little resemblance to that taken in 1883 as the average picture of a man in his fifties bears to a photograph taken when he was a few months old. Conversely, the facsimile of the British system of 1943 would appear to be merely an enlargement of its photograph of 1913.

The British system, like the German, had its inception in the political ambitions of a single man. The German law was passed because Bismarck waited to defeat the Social Democrats. At the dinner which marked the twenty-fifth anniversary of the launching of the British scheme, Lloyd-George admitted that "the need of the Liberals to take votes from the growing Labor Party had more to do with the adoption of health insurance than the need of the poor for medical care." As in Germany, the political benefit derived by the ruling party from the enactment of the law was short-lived, for the Labor Party made health insurance a plank in their platform as soon as they realized how popular it was with the working classes.

And popular it was. There was a continuous pressure to force the inclusion of an ever greater part of the working class, until 90 per cent were covered by 1944. However, this did not represent much

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more than a third of the total population because, since the fundamental medical benefit was not administered by the Societies, there was no general adoption of a dependents' benefit as there was in Germany.

The expansion of the British system took the form of including more and more manual workers until all were covered and then gradually raising the income limit for nonmanual workers from £160, the limit in force prior to 1919, to £420, the limit established by the law of 1941. In 1944 the age limits were lowered from 16 to 14 years and from 70 to 65 years (60 for women). The drop at the lower limit closed the gap between medical inspection in school and medical care under the health insurance system. The reduction of the upper limit to 65 followed the inauguration of the old age contributory insurance scheme which applies to all over 65. Its implementation in 1925 broke the last tie between the national health insurance scheme and old age protection.

The administration of all cash benefits was turned over to the Approved Societies, many of which had existed prior to the implementation of the health insurance system. However, these Friendly Societies, as they had been known, had fallen upon evil days by the early part of the twentieth century, and most of them were in financial straits. Hence, they welcomed the chance to administer the cash benefits, not only because that would give them a certain income but because the law of 1911 provided them with a credit of £10,000,000.

It was necessary to set up new organizations to provide for the great influx of members. Here another factor entered the picture, the British industrial insurance companies. When the plan was first proposed these companies were fearful lest enactment result in loss of business for them. The government knew that if the insurance companies fought the bill, it could never be passed. Therefore, two concessions were granted. There would be no funeral benefit in the British system, and the companies would be allowed to set up their own societies for the administration of cash benefits. After Lloyd-George acceded to the companies' demands, the insurance agents became enthusiastic boosters of the plan, and the slogan of the campaign, "Ninepence-worth for fourpence," became a household word.

These insurance societies and the Friendly Societies, taken together, formed the Approved Societies. In the course of time some became

extremely strong, while others amalgamated or dropped by the wayside. In 1912 there were 2,200 Approved Societies; in 1941, there were only about 800.

The big internal force which strengthened the strong at the expense of the weak was competition. In one sense the Societies were in a more advantageous position to carry on a competitive campaign than the Kassen of Germany because in England there were no industrial or territorial restrictions. If a worker decided to join a certain Society he was perfectly free to do so unless his physical condition disqualified him. However, the British Societies were limited as to funds and to the benefits they could offer. The British law did not give the Societies any leeway in the matter of contributions except in case of a deficit. The money for the benefit was collected on a flat rate basis from employers and employees and turned over to the Ministry of Health, which in turn paid the Societies a fixed amount for each member and a governmental subsidy for administration.

The power of the Societies to offer generous benefits was curtailed not only by lack of funds but also because authority over medical benefits was given to another group of organizations. Thus the Societies only rarely provided medical coverage for the dependents of the insured workers and for the most part had to content themselves with paying higher cash benefits than were required by law.

The British law, like the German, set forth certain minimum benefit standards to which the Societies had to conform. The wage loss benefit, instead of being a certain proportion of the wage, was a flat amount for all men workers between the ages of 21 and 65. It was a small amount, never higher than 18s., because the British had the theory that the benefit should furnish only a "floor of protection" instead of being an indemnification for the actual wage loss. However, the Societies paid more liberal benefits than they were compelled to pay. In 1941 it was estimated that about three-fourths of the workers belonged to Societies which paid disability benefits which were 25 per cent above the legal minimum. In addition, many provided extra medical benefits.

In Britain as in Germany there was much malingering. In 1938 a medical survey showed that 15 per cent of all those receiving benefits were malingerers. The Societies tried to deal with the problem, sometimes by appealing to the Regional Medical Officer to referee the case.

During 1930, in about 30 per cent of the cases reviewed the workers were sent back to work; in 1928, the ratio was 60 per cent. Furthermore, the Societies employed "health visitors," co-workers of the claimants, who had sources of information as to the validity of claims which would not be available to an officer of a corporation or a governmental official.

The crucial question is: Has this administrative setup been more successful than the German? In 1925 the Royal Commission found that the administration of the cash benefits by Approved Societies was inefficient and extravagant.

The efficient administration by the Societies was hampered by what the Royal Commission called "the senseless dissipation of members among many different Societies." For example, in 1925 investigators found that in Glasgow there were ninety-eight Societies which were represented by only one member. This is one reason why the British costs of administration averaged about 15 per cent of all expenditures as compared to 6.5 per cent in Germany. The claim rate in England almost doubled during the first twenty-five years of the insurance system, for which the Societies blamed the physicians. However, the Societies had no power to discipline the physicians or to bar the worst offenders from insurance practice. The root of the problem went back to the preinsurance days when a bitter battle raged between the Friendly Societies and the physicians' clubs. Because of this old enmity it was considered impolitic to entrust the administration of the statutory medical benefit to the Societies.

Therefore, Insurance Committees composed of employees, employers, doctors, and representatives of the county and Ministry of Health were formed to provide insured workers with medical treatment and the proper drugs and medicines. At first any qualified physician could become an insurance doctor merely by registering with the Insurance Committee of his district. Any worker who wanted a particular physician could sign on that physician's panel. However, this condition of laissez faire did not last long. In the interests of economy the Insurance Committees wanted the doctors to prescribe the cheapest drugs, while on the other hand the workers, impelled by a desire to get their money's worth, demanded the most expensive medicines. Physicians had to steer a course between the two horns of this dilemma.

Every physician was anxious to be popular with the workers. In the first place, he realized that there is a definite therapeutic value in a cordial rapport between a patient and his physician. Also, he wanted a large insurance panel, and the size of the panel was determined by the popularity of the physician. Thirdly, most doctors got about half of their incomes from their private practice, and to a large degree the private patients were the dependents of the workers. Therefore, the popularity of a physician with the workers would determine his income from private work. On the other hand, if the doctor did not comply with the demands of the Insurance Committee, he could be struck off the panel or fined to an arbitrary degree.

The doctors resented what they termed "lay interference." Much friction arose between physicians and insurance authorities over the validation of claims by the physicians followed by disallowance of the claims by the health visitors. The irritation caused by lay interference plus the cordial relations which existed between the doctors and the Regional Medical Officers who umpired claim disputes, caused the doctors to advocate the adoption of a law to force the Insurance Committees to consult a committee of physicians on all questions of a medical nature. The passage of this law in 1942 was a great triumph for the medical profession.

If the doctors were bedevilled on one side by Insurance Committees, they were equally harassed by their patients, who, impelled by the insurance psychosis, demanded more and more treatment and drugs. The demands for treatment became so numerous that the average doctor had to see from thirty to sixty patients a day.

As in Germany, authorities differ on the question of whether the care given British workers was as good as they would have had under a system of private medicine. An investigating committee from the Michigan State Medical Society reported that "the introduction of health insurance has not exerted a deteriorating effect on the quality of medical service." On the other hand, Mr. Ernest Bevin said that "the medical service given the working classes is a tragedy of incompetence." Probably the fairest evaluation of the medical service under health insurance was made by a writer in the English periodical, *Labor-Management*, in 1943, who said that it developed with "patches of brilliance and patches of gross inefficiency."

Since the introduction of health insurance, the British worker has

experienced more and more sickness, as judged by the claim rate both for the wage loss benefit and for medical attention. Some of this apparent increase in sickness may result from the fact that the worker now takes more and more of his minor illnesses to his doctor, some, from a possible deterioration in the quality of medical care. A part of the increase in sickness is undoubtedly the result of insurance psychoses.

The introduction of health insurance has, then, changed the worker's physical and probably his moral well-being. How has it affected him financially? From all outward appearances he is better off under health insurance than he was under private practice. Despite the increase in the per capita cost, the male employee's contribution increased only from 4d. in 1911 to 5½ d. in 1941. The governmental subsidy actually decreased proportionately during that period. On the other hand the employer's tax almost doubled (3d. in 1911 to 5½d. in 1941). But five actuarial evaluations have shown an increasing proportion of workers in Societies with deficits, although never since the inauguration of the system has the benefit received by the average worker equalled the contribution paid by him. Notwithstanding, the workers like health insurance. By and large, they agree with the dictum of the Royal Commission that the system "has on the whole been successful in operation."

The chief criticisms from various sources have been the uneconomic administration of the wage loss benefit, the meagerness of the benefits, and the lay interference with medical procedure, paricularly by the Insurance Committees.

At present (February, 1946) it seems probable that there will be new and sweeping changes in the medical side of health insurance. If the recommendations of the white paper of February, 1944 are put into effect by the Labor government, not only will the entire population be furnished with both specialist and general practitioner care, but lay interference with practicing physicians will be eliminated. Under the new plan, the war development will be perpetuated by having the local authorities take over the administration of the voluntary hospitals and their adjunctive specialists. Similarly, home nursing, which is at present almost entirely in the hands of the voluntary district nursing association, will be administered by the local authorities. In short, each area is to have a self-sufficient specialist,

hospital, and nursing service. Doctors are to be organized around health centers by the Central Medical Board, which will be responsible to the Ministry of Health. This board will be able to admit a doctor to insurance practice or bar him from it. It will have the power to assign doctors to a center and to contract for the remuneration to be paid the center as a whole. Doctors not connected with a center will be paid on a capitation basis. It is estimated that such a system will cost about two and one-half times the present outlay for medical expenses.*

In short, the criticisms of the medical situation made by the Societies as early as 1925 are about to be answered by an entire reorganization of British medical economy along the lines pursued in Germany just prior to the war. Will the fate of these Societies be like that of the Kassen—will they be taken over, lock, stock, and barrel, to become a powerful bureaucracy through which the British people may be regimented? Only time will tell.

* Since this paper was submitted for publication, these changes have became law and will go into effect on Jan. 1, 1948.

There is a normal and cheerful as well as a morbid, crabbed, and unhappy form of old age.

SIR HUMPHREY ROLLESTON

CURRENT COMMENT

Cooperative Living

Realizing that frustration is not inevitable, nor is old age a disease, the Cooperative Residence Club, Inc. of New York City has as its aim the attempt to give older people their full share of participation in their community. The residents of the Club are not only advanced in years, but are newcomers to this country, refugees. Many of them are haunted by sad experiences in their home countries, were uprooted late in life, and often have difficulty in adjusting to a new language, customs, and way of life. It is often hard for them to find a feeling of security. Most of them come from urban, middle class central European background and have had little experience of a voluntary character in group living.

Many who have done little in the way of housework and in caring for themselves have learned to help with the work of the club and keep their own rooms in order. Two of the residents, a former physician and a former businessman, who had never thought of entering the kitchen in their own homes, now almost daily peel potatoes. Each person is assigned tasks suitable to his ability and, as far as possible,

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The hieroglyphics, "The Beginning of the Book for Transforming an Old Man into a Youth," at the top of this editorial page, are from the Edwin Smith Surgical Papyrus, translated by Professor John Breasted, University of Chicago Press.

preference. In addition, residents share together recreational and educational programs, including English classes, book clubs, and concerts and recitals by professional artists.

Each resident, upon entrance, is required to buy ten shares in the cooperative at $10 each. A substantial reserve is set aside for the original purpose of meeting emergencies, and the rest is available as a working capital for general purposes and the development of the club.

Several outside workers give their time and talents to aid the club. Artists, physicians, lawyers, real estate men, accountants, and teachers have contributed much valuable consultation and professional help.

At the end of the fiscal year 1945, the club had 41 residents, including 4 couples, 32 single women, and 1 single man. Two were over 90, 6 between 80 and 90, 19 between 70 and 80, and 14 between 60 and 70. Fourteen of the residents were gainfully employed during the year, while others worked as volunteers with local social agencies.

The club has an ever increasing waiting list, but there is room for a turnover of only approximately 10 each year. There is a great need for additional units such as this one, as the delay in admittance of many of the applicants is bringing increased hardships for them. (Annual Report of the Cooperative Residence Club, Inc. for 1944-1945.)

Medical Memorial Fund

More than half a million people in the United States die each year from diseases of the heart and arteries, but only 17 cents per death is spent on research in this field. In contrast, investigation on infectious diseases received $6 per death in 1940.

As the world is adjusting to the postwar era, now is the time to expand research programs in the important field of the degenerative diseases of increasing age. In addition, basic study of the processes of aging must be undertaken if a clear understanding of the cause and nature of disease is to be acquired.

In 1940, the foundations granted $4,700,000 for medical research. At least ten times that amount is needed yearly if the most prevalent diseases are to receive proper attention.

To meet this situation a new foundation—Medical Memorial Fund,

Inc.—has been created. Medical Memorial Fund receives its income largely from memorial gifts. These are contributions to medical research made at the time of the death of friends or relatives. As the fund receives each memorial gift, it sends a dignified memorial certificate to the member of the family of the deceased specified by the person making the gift. The donor receives an acknowledgment card which serves as a receipt for tax purposes.

This plan appeals to many people as an appropriate expression of sympathy—a lasting memorial of benefit to mankind. Here is an opportunity for each individual to make a contribution. A fund collected as one hundred gifts of $10 is as valuable as $1,000 from one person.

The chairman of the board of trustees of the Medical Memorial Fund is Harlow Shapley of Harvard University, and the president is Henry S. Simms of Columbia University. Sound administration of the funds is guaranteed by a distinguished board of trustees and scientific committee.

Honorary members of the lay council include Chauncey Belknap, John W. Davis, Marshall Field, Herbert Hoover, and Albert N. Williams.

Members of the board of trustees are A. J. Carlson, Russell L. Cecil, John V. Duncan, Guy Emerson, Harry Goldblatt, Theodore G. Klumpp, Albert D. Lasker, Chauncey D. Leake, William Loeb, Currier McEwen, William deB. MacNider, Donald G. Price, Harlow Shapley, Henry S. Simms, J. Murray Steele, Lowell Thomas, Marvin R. Thompson, D. D. van Slyke, A. Ashley Weech, George H. Whipple, and Mark Woods.

The scientific committee is composed of J. Murray Steele, A. J. Carlson, Russell L. Cecil, Harry Goldblatt, Chauncey D. Leake, Theodore G. Klumpp, William de B. MacNider, Marvin R. Thompson, Henry S. Simms, D. D. van Slyke, A. Ashley Weech, and George H. Whipple.

Individuals who wish to make their small contribution to the future will welcome the establishment of this unique foundation for medical research. The offices are located at 630 West 168th Street, New York 32, New York.

BOOKS

THE ME'S IN MY SOCIAL COMPLEX

THE WAY OF AN INVESTIGATOR, Walter B. Cannon, W. W. Norton and Company, Inc., New York, New York, 1945. $3.00.

Although Dr. Cannon states in the preface that "admittedly this is a book about one of the me's in my social complex—in the main about me as a scientific worker," a glance at the table of contents reveals much more than science. And reading brings to mind many of the deeper attitudes and viewpoints of one of America's greatest scientists and humanists—for thirty-seven years George Higginson professor of physiology at the Harvard Medical School.

Fate was acting under a guiding hand when in 1870 Colbert Hanchett Cannon, a railroad worker, and Sarah Wilma Denio, a young school teacher, were brought together in Prairie du Chien, the site of Fort Crawford, where William Beaumont made his classic observations on digestion, in 1820. A century later their son, Walter Bradford Cannon, was destined to add immeasurably to our knowledge of the digestive tract.

There are few problems of the young investigator, or the professor, or the administrative head of a department, which are not covered. For example, in the chapter on "Passing on the Torch" there are discussions of the advantages of using productive scholars for administrative services in American universities. The young physician wavering between a career of research and of practice may well read and reread the chapter on "Fitness for the Enterprise." The traits important for a life of investigation are listed as "curiosity, imaginative insight, critical judgment, thorough honesty, a retentive memory, patience, good health, generosity, and a humble attitude." The words of encouragement from the philosopher to the young man are: "A beginner who seriously plans a life of productive scholarship, should not be disheartened if he thinks his qualifications do not meet requirements. Training and practice may not lead to perfection, but they will surely compensate for early inadequacies."

The young investigator who is worried about the problem of outside demands on his or her time will get sound advice in the chapter on "Being a Citizen." Although admitting the advantages of uninterrupted time for research, Cannon states: "Nevertheless, the scientist is also a citizen and may feel a compulsion to engage in services which he as a citizen has opportunities to perform." The personal acceptance of this dictum is exemplified in Walter Cannon's long defense of medical research, his vigorous support of the Spanish Republic, his participation in aid to China before general realization of the threat to peace from the Japanese, and his acceptance of the presidency of the American-Soviet Medical Society. Would that more scientists might heed the words: "The unchecked pursuit of [the] most cherished desires [of the scientist] depends immediately on the liberty which a democratic government most reliably provides. He does well, therefore, to watch over it and, if necessary, to go forth from his 'serene attachment to the processes of inquiry and understanding' to battle for its security."

Walter Cannon was deeply interested in gerontology; he was a charter member of the Club for Research on Ageing. In the last chapter, entitled "The Fruitful Years," he gives a bird's eye view of his thoughts about the period of life in which there is greatest scientific productiveness, the discrepancy between physiologic old age and chronologic old age, and adjustment for retirement.

In a few words, pages 219 and 220, there is a complete thumbnail sketch of the "bodily changes" as "the decades slip by"—the pigment spots on the skin, the long hairs in the nose and ears, the shaggy eyebrows, the creaky joints, limitation of the effectiveness of the homeostatic devices, rigidity of expansion of the chest, stiffening of the arteries, and change in the near point of clear vision leading to what Holmes termed the "trombone age."

A guide for research in gerontology may be gained from: "The physiological limitations of old age arise because our bodies are composed of a group of cooperative organs. All goes well as long as each one performs adequately its role in the complex. It is when an important organ becomes impaired and fails to 'play the game' that a break occurs." In this quotation, the word "physiologic" may well be replaced by "social" and "organs" by "activities," for a basic statement on the sociologic aspects of aging. Perhaps the author sensed this

transformation when he goes on to say: "Providentially, as long as the blood vessels of the brain supply that extraordinarily delicate and sensitive structure with an abundant supply of oxygen and sugar, clarity of the mental processes is preserved and pleasant social relations, as well as cherished personal activities, can be continued."

Perhaps Dr. Cannon had a premonition of coming events when he quoted from Dr. Mitchell as the closing words of the book:

> "I know the night is near at hand.
> The mists lie low on hill and bay.
> The autumn sheaves are dewless, dry;
> But I have had the day."

ROBERT O. MOORE

BOOKS RECEIVED

Books received since April 1, 1946 are acknowledged in the following list. Insofar as space and time permit, some will be selected for review in a later issue, but it is unlikely that all will be reviewed.

EVOLUTION OF PLASTIC SURGERY, by Maxwell Maltz, Froben Press, New York, 1946, $5.00, 368 pages.

TREATMENT OF ARTHRITIS AND RHEUMATISM IN GENERAL PRACTICE, by Bernard Aschner, Froben Press, New York, 1946, $5.00, 340 pages.

BIOGENERGETICS AND GROWTH, by Samuel Brody, Reinhold Publishing Corporation, New York, 1945, $8.50, 1023 pages.

A FUTURE OF PREVENTIVE MEDICINE, by Edward J. Stieglitz, The Commonwealth Fund, New York, 1945, $1.00, 73 pages.

THE WAY OF AN INVESTIGATOR, by Walter B. Cannon, W. W. Norton and Company, Inc., New York, 1945, $3.00, 229 pages. (Reviewed in this issue, page 181.)

SOCIAL ADJUSTMENT IN OLD AGE. A RESEARCH PLANNING REPORT, Social Science Research Council, New York, 1946, 222 pages.

AMBULATORY PROCTOLOGY, by Alfred J. Cantor, Paul B. Hoeber, New York, 1946, $8.00, 524 pages.

ADRENAL a-drē′-nal—noun and adjective (L. ad—near+ren—kidney)

The ductless gland situated near the upper end of each kidney, which secrets a chemical substance that causes the blood vessels to contract and expand according to the needs of the tissues for a blood supply.

ANDROSTERONE an-dros′-ter-ōne—noun (ἄνδρος—man)

The pure crystalline form of one of the male sex hormones. These hormones, known as androgens, are chemical substances, secreted by the testicles and present in the urine. They possess masculinizing properties, and though found in the female, they predominate in the male.

ANTIBODY an′tē-bo′dy—noun (ἀντι—against)

One of the means of defense which the body has against bacteria. Antibodies develop in response to certain poisonous substances produced by bacteria in the tissues or blood, and counteract the harmful effects of these poisonous substances.

ARTHRITIDES ar-thrī′-ti-dēz—noun (ἄρθρον—joint+ιτις—inflammation)

Various inflammatory diseases of the joints.

BACTERIOPHAGE bac-ter′-i-o-faj—noun (βακτήριον—little rod+φαγεῖν—to eat)

An agent, too small to be seen with a microscope, which destroys bacteria. Thus it is a means of body defense.

BASAL METABOLIC RATE bā′-sal me-ta-bol′-ik—noun (μεταβολή—change)

It has been worked out that, according to the age, weight, and sex of an individual, he should use a certain amount of energy to maintain the body functions essential to life, such as respiration, circulation, and glandular activity. The amount of energy thus used can be measured by the heat produced by an individual, 14 to 18 hours after eating and when the individual is at rest but not asleep. This is known as the

basal metabolic rate. If the individual uses more energy than is normal for him the rate goes up, if less, down.

BRONCHITIS bron-kī′-tis—noun (*βρόγχια*—air tubes+*ιτις*—inflammation)

Inflammation of the lining of the air passages of the lungs. In acute cases it is characterized by fever, pain in the chest, and cough. Repeated attacks of bronchitis result in a chronic form of the disease and secondary changes in the lungs.

CARDIOLOGIST car-di-o′-lo-jist—noun (*καρδιά*—heart+*λόγος*—discourse)

A physician specially trained in the study and treatment of heart disease.

CONGENITAL con-jen′-i-tal—adjective (L. congenitus—born together)

Born with a person; some defect resulting from improper development.

CORONARY THROMBOSIS cor′-onary throm-bō′-sis—noun (L. coronarius—of or belonging to a wreath or crown. *θρόμβος*—clot +*ωσις*—a termination denoting a diseased or morbid process)

The formation of a blood clot in a branch of the arteries which supply blood to the heart muscle, resulting in obstruction of the artery and death of the tissue in that area of the heart supplied by the blocked vessel.

ELECTROCARDIOGRAM elec′-trō-car′-di-o-gram—noun (*ἤλεκτρον*—amber. A prefix denoting some connection with electricity. *καρδία*—heart+*γραμμα*—mark)

A tracing of the electric current produced by the contraction of the heart muscle. It is used to discover abnormalities in the action of the heart.

ESTRADIOL es-tra′-di-ol—noun (*οἶστρος*—gadfly; rutting, or sexual excitement in female animals)

One of the female sex hormones.

ESTROGEN es′-trō-jen—noun (*οἶστρος*—gadfly; rutting, or sexual excitement in female animals+*γεν*—to form)

A collective term used to refer to a group of chemical substances which are produced in the ovary and placenta and control the activities of the female sex organs. Estrogens are known as the female sex hormones. They are also found in the male but to a much lesser extent.

GLYCOGEN glī′-co-jen—noun (*γλυκύς*—sweet+*γεννᾶν*—to produce)

A substance formed in the liver from carbohydrates, and converted into the simple sugar known as dextrose as the needs of the body require.

GONADOTROPHIC go-nad′-o-trō′-fik—adjective (γονή—semen+τροπή—turn)

Pertaining to influence on the ovaries or testes (which are known as gonads).

HEMATOLOGIC hē′-ma-to-lo′-jik—adjective (αἷμα—blood+λόγος—discourse)

Relating to the blood.

HEMOLYTIC JAUNDICE hē′-mo-lĭ′-tik jahn′-dĭs—noun (αἷμα—blood+λύσις—dissolution. L. icterus, ἴκτερος—jaundice)

Jaundice itself is not a disease but a symptom. Jaundice results when bile pigment (bile is the yellowish fluid secreted by the liver) is deposited in the skin and mucous membranes, with a consequently yellow appearance of the skin. Normally, bile is poured into the intestine from the liver and aids in digestion. However, if the liver is affected with some disease or disorder, it may become unable to function properly. In addition to the yellow bile pigment, in jaundice there is found in the blood, tissues, and urine a red bile pigment, known as bilirubin (L. bilis—bile+ruber—red). Bilirubin is manufactured by the liver out of the oxygen-carrying red pigment of the red blood corpuscles. Hemolytic jaundice, which is a rare and chronic disease usually inherited, is caused by abnormal fragility of the red blood corpuscles. Excessive amounts of the oxygen-carrying red pigment of the red corpuscles are liberated by the liver and thus excessive amounts of bilirubin are produced.

HISTOLOGIC his′-to-lo′-jik—adjective (ἱστός—web+λόγος—discourse)

Concerning the minute structure and composition of the tissue.

HORMONES hor′-mōnes—noun (ὁρμάνειν—to excite or arouse)

Chemical substances, produced in various organs of the body such as the thyroid gland, the pituitary gland, and the ovary, which are carried to other organs of the body by the blood stream and arouse these latter organs to activity.

INVOLUTIONAL in′-vo-lū′-shun-al—adjective (L. in—into+volvere—to roll)

Going backward. Pertaining to the changes produced by aging.

MACROPHAGE mak′-ro-faj—noun (μακρός—large+φαγεῖν—to eat)

A large wandering cell, which engulfs bacteria and thus helps protect the body from disease.

MITOSIS mī-tō′-sis—noun (μίτος—thread)

The division of cells.

NECROSIS ne-krō′-sis—noun (*νέκρωσις*—deadness)

Death of a certain portion of tissue in the body.

NEOPLASTIC nē′-o-plas′-tik—adjective (*νέος*—new + *πλάστις*—formed)

Pertaining to a new and abnormal formation in the body, such as a tumor or cancer.

PATHOGENIC path′-o-jĕn′-ik—adjective (*πάθος*—disease + *γεννᾶν*—to produce)

Giving rise to or producing disease. For example, the tubercle bacillus, since it produces tuberculosis, is a pathogenic organism.

PHAGOCYTE fag′-o-sīte—noun (*φαγεῖν*—to eat + *κύτος*—cell)

Any cell which engulfs bacteria. Thus phagocytes (of which *macrophages* are one type) are an important means of defense which the body has against disease.

PLETHORIC plĕ-thor′-ik—adjective (*πλησθώρη*—fulness)

Characterized by enlargement of the blood vessels, an excess of blood, and fulness of the pulse. With plethora there is a feeling of tension in the head, an abnormally red complexion, and a tendency to nosebleed.

SPLENECTOMY splen-ĕk′-to-mē—noun (*σπλήν*—spleen + *ἐκτομή*—excision)

Removal of the spleen by surgical procedure.

STASIS stā′-sis—noun (*στάσις*—halt)

A stopping or halt. For example, a stoppage of the flow of blood in any part, or lack of movement of the contents of the intestine.

SUBCUTANEOUS sub′-kū-tān′-e-us—adjective (L. sub—under + cutis—skin)

Beneath the skin.

SYNERGISTIC sĭn′-er-jĭs′-tik—adjective (*σύν*—together + *ἐργόν*—work)

Acting with another agent; cooperation on the part of two or more structures of the body, drugs, etc.

THROMBOCYTOPENIC PURPURA throm′-bō-sī-tō-pēn′-ik pur′-pur-a—noun (*θρόμβος*—clot + *κύτος*—cell + *πενία*—poverty. L. purpura—purple)

Purpura is a disease characterized by the formation of purple patches in the skin and mucous membranes, caused by the escape within the body of blood from the vessels. Thrombocytopenic purpura is a severe form of purpura with hemorrhages from the mucous membranes because of a great reduction in the number of blood platelets, which cause the blood to clot.

VIRUS vī′-rus—noun (L. virus—poison)

A living, disease-producing organism, too small to be seen with the ordinary microscope. Smallpox, for example, is produced by a virus.

VISION OF 20/40

Eyes which see at not over 20 feet what they should be able to see at 40 feet.

h the
irus.

see at